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ELECTRICAL PERFORMANCE OF MIS BY VARYING THE P3HT FILM THICKNESS

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DECLARATION

I It is declared that all the materials in this report are the results of my own work and all materials which are not the result of my own work have been clearly acknowledged in this report.

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ABSTRACT

In this thesis, the MIS device was fabricated using P3HT and PMMA:TiO_2 as semiconductor and insulator layer respectively. The spin coating technique was used as the deposition process. The electrical and physical properties of the MIS were studies by varying the P3HT semiconductor film thickness. The MIS was fabricated on top of indium tin oxide (ITO) coated glass acting as substrate and bottom electrode. The goal of this study is to investigate the performance of MIS by varying the thickness of the P3HT semiconductor film.

P3HT film was prepared by dissolving a 15 mg of P3HT powder in 15 ml chloroform to obtain P3HT solution. Then, the solution was spin coated on glass substrate to form the P3HT semiconductor film. The deposition speed was varied from 500 rpm, 1000 rpm, 1500 rpm, 2000 rpm and 2500 rpm to obtain different P3HT film thickness. Then, the P3HT film was characterized for it electrical and physical properties. The physical properties result of P3HT film shows that the relationship between thickness, conductivity and surface roughness of the P3HT when deposition speed is increased. The thickness of the P3HT film decreased by 317.69, 276.95, 239.03, 193.17 and 151.53 nm for 500, 1000, 1500, 2000 and 2500 rpm, respectively. The conductivity is 0.0731, 0.09402, 0.1039, 013793 and 0.19015 S/cm and the surface roughness are 145.628, 11,74, 8.872, 4.088 and 4.663 nm for 500, 1000, 1500, 2000 and 2500 rpm, respectively. P3HT film roughness also can effect on MIS performance. The 500 rpm give the biggest value of surface roughness which is 15.628 nm compare to other samples. The surface roughness of P3HT film can be minimizing by increasing the deposition speed. Result from the characterization shows that P3HT with 1500 rpm has the optimized compare to other deposition speed.

MIS with different P3HT film as semiconductor were demonstrated. The device performance displayed by MIS indicates that P3HT semiconductor is compatible with PMMA:TiO_2. The improvement in the threshold voltage, V_{TH} of MIS was observed when P3HT film thickness is reduced. The V_{TH} is in the range of -2 to -13 V and for rotational speed of 2500 rpm presented the smaller V_{TH}.

The conductivity and electrical properties P3HT thin film was investigated from *I-V* characteristic. It shows that all MIS samples have resulted the lower of P3HT film thickness has a fast operating voltage. It can see that have improvement on V_{TH} when

the P3HT film thickness is reduce. From the leakage current, *J* characteristic, it can be observed that the P3HT layer is suitable with PMMA:TiO_2 layer. The *J* value is always on the 10^{-8} A/cm^2. *C*-*V* characteristics of MIS were discovered by charge stored in the MIS device. Overall results show that the inversion region for the *C*-*V* curve has change the operation from high frequency (HF) to low frequency (LF) by increasing the spin speed. Surface morphology proved that the increasing spin speed not only reduced the thickness, it also reduced the surface roughness for P3HT films.